(12) UK Patent Application (19) GB (11) 2 212 038 (13) A

(43) Date of A publication 12.07.1989

(21) Application No 8825629.2

(22) Date of filing 02.11.1988

(30) Priority data
(31) 8725599 (32) 02.11.1987 (33) GB

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(51) INT CL⁴
H05B 3/00 3/44

(52) UK CL (Edition J)
H5H HAA5 H111 H130 H157 H179 H193 H196
H213 H231 H234 H250

(56) Documents cited
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(58) Field of search
UK CL (Edition J) H1F FA FF, H5H HAAX1 HAA5
HAA6 HAA9 HAX2
INT CL⁴ H05B

(54) Reflective cavity heat source

(57) Especially for thermal shock test equipment where a very high heating rate is to be applied to a test sample, a heat source comprises an internally reflective enclosure containing one or more heaters, e.g. quartz halogen lamps 211. A relatively small aperture 28 in the wall of the enclosure leads to the test sample 29 supported on a sliding tray 212 so that it can be safely entered into the heating position. The enclosure forms a kind of "integrating sphere" (known in the context of scientific apparatus for measuring small amounts of received optical radiation) but combined with the internal heat source (lamps) forms a powerful source of concentrated heat (Figure 4).

The source may be a quartz bulb silver plated over all but a 1 cm diameter circle and containing one or three resistance filaments.

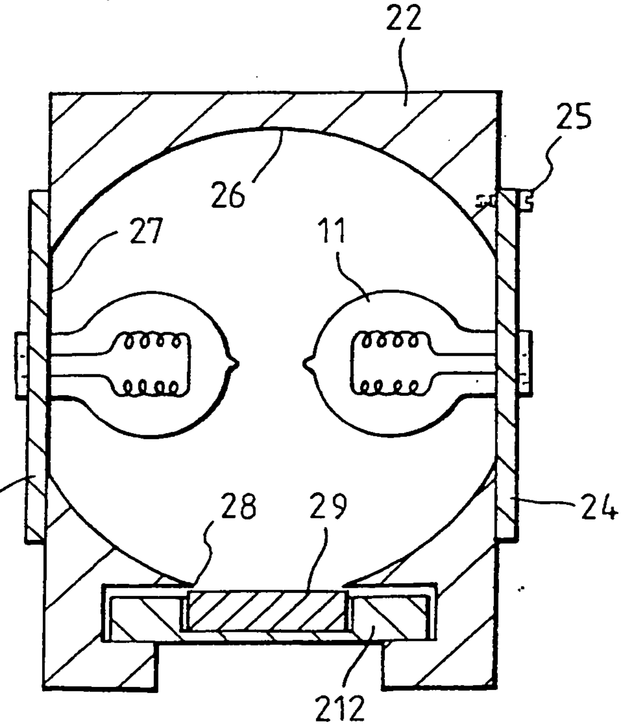

Fig.4.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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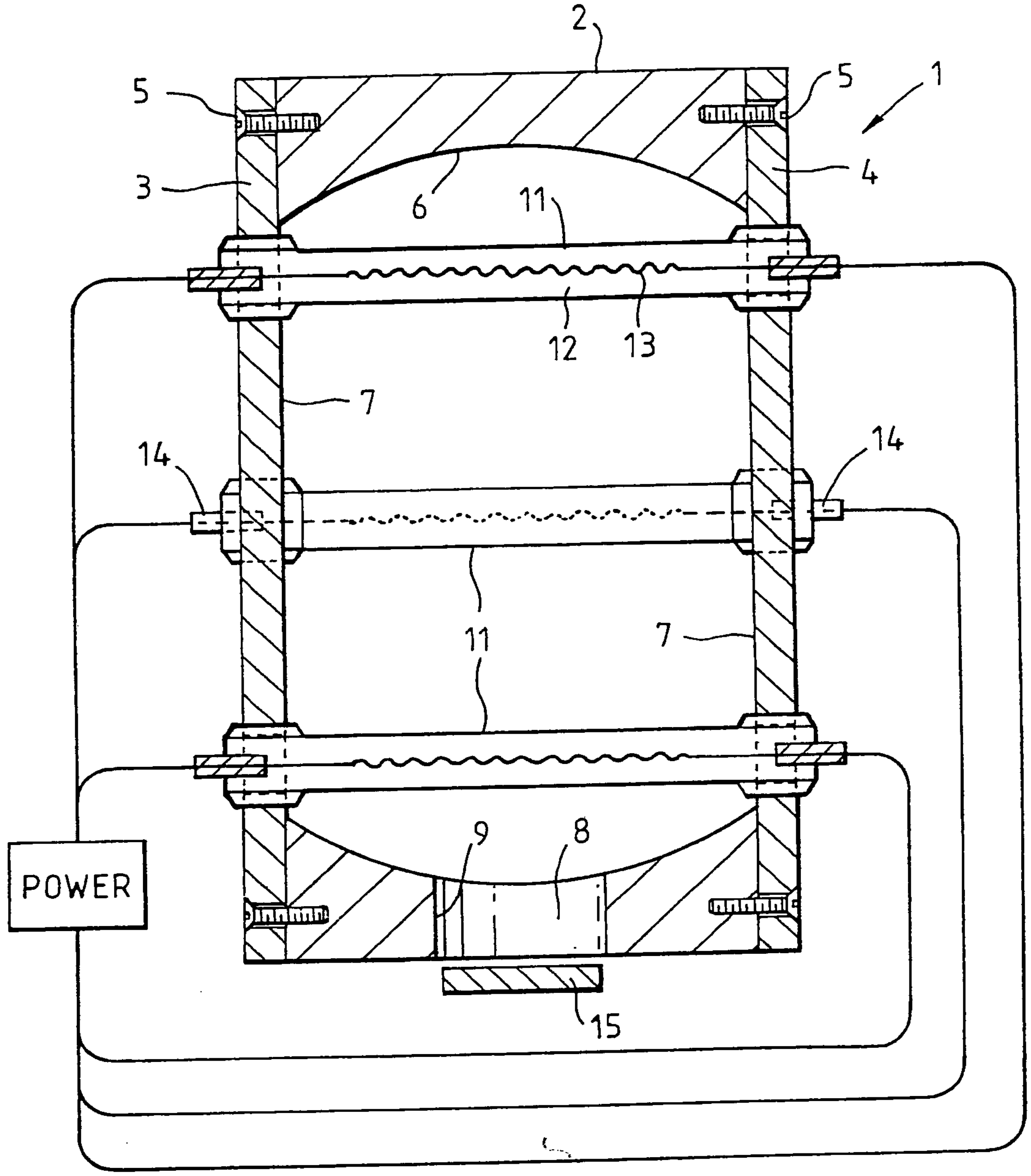

Fig.1.

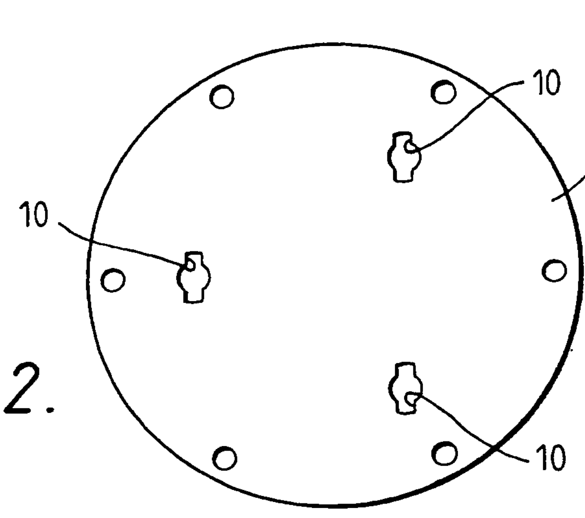

Fig.2.

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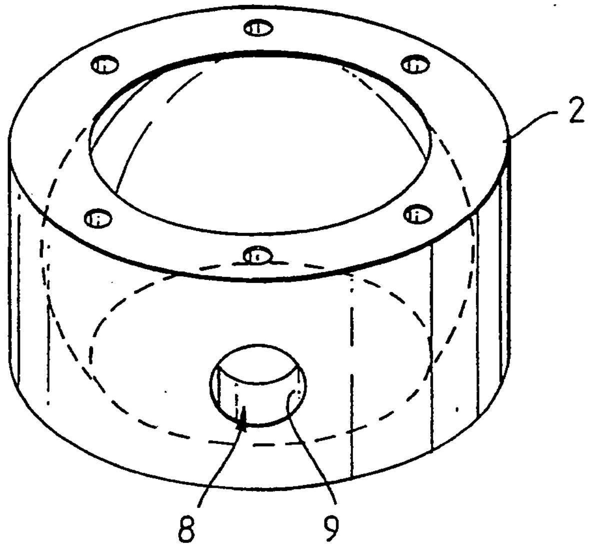

Fig.3.

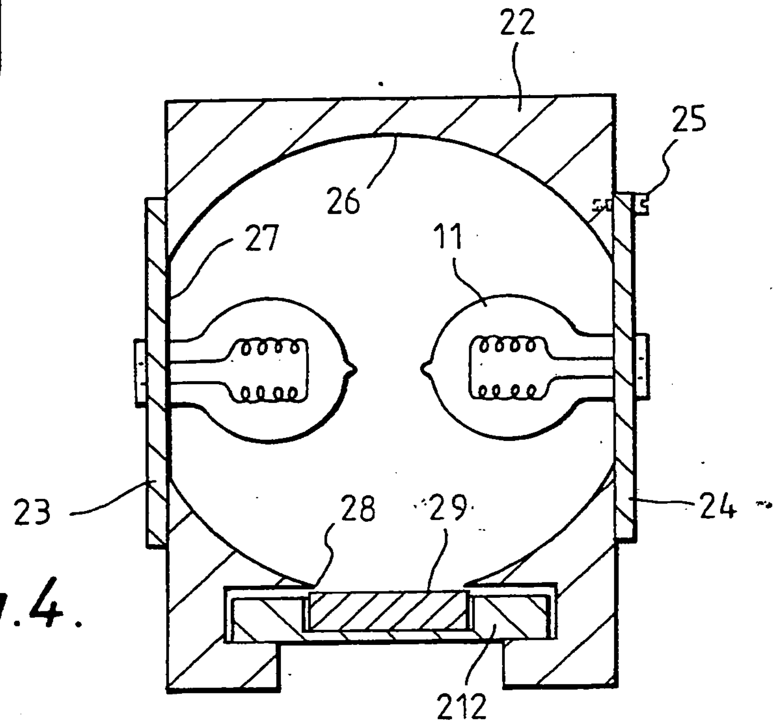

Fig.4.

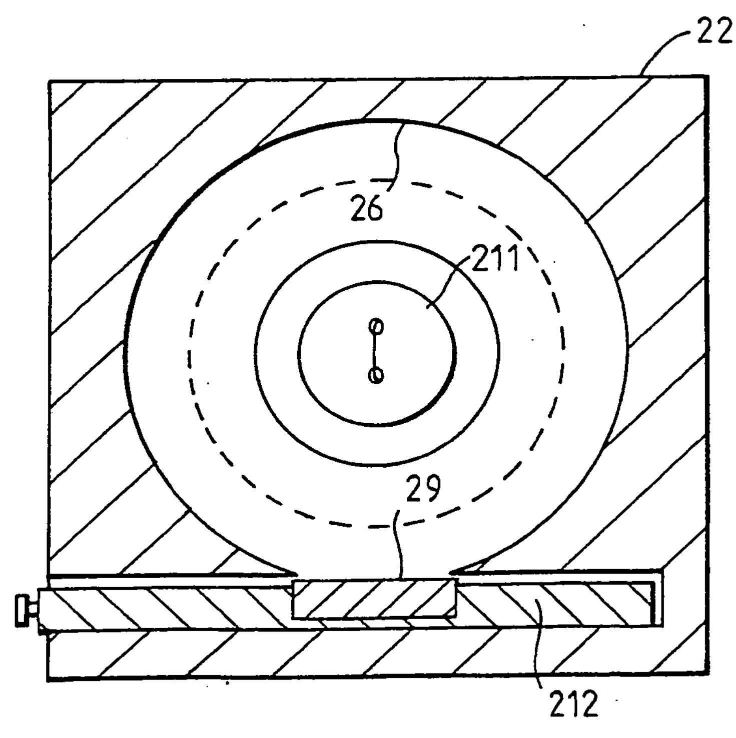

Fig.5.

HEAT SOURCE

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This invention relates to a heat source, more particularly but not exclusively to a heat source for rapidly heating a sample of material to a high temperature in order to carry out thermal shock tests on the sample. The invention also relates to thermal shock test equipment using such a heat source. The sample may be of material being evaluated for use in optical equipment, for example for use as a window or for a coating on such a window.

A valid thermal shock test may require a sample to be heated at a rate and to a temperature which is not easily achievable except by relatively complex and expensive equipment. The kind of heating rate which may be desirable is of an order that might be achieved by applying the flame of an oxy-acetylene torch onto the sample. Electric cooker hobs with infra-red radiants using relatively low temperature quartz halogen lamps have recently come onto the market. The temperature and heating rate obtainable with that arrangement would not be sufficient for the purpose mentioned above, the heating power being distributed over a large area.

The object of the invention is to provide a heat source able to heat a test sample, such as an item of optical equipment, to a high temperature very quickly and yet which is comparatively inexpensive, convenient and safe to use in a laboratory.

According to one aspect of the invention there is provided a heat source comprising a hollow enclosure of which substantially the whole of its internal surface is optically reflective and which contains one or more high-temperature

electric lamps, an aperture being provided in the enclosure for heat generated by the or each lamp to emerge from the enclosure.

According to another aspect there is provided a method of testing an item for heat shock in which the item is positioned close to an aperture in a hollow enclosure of which substantially the whole of its inner surface is highly reflective and which contains one or more high temperature electric filament lamps, the method including energising the lamps whereby the heat therefrom emerges through said aperture onto said item.

For a better understanding of the invention, reference will now be made by way of example to the accompanying drawings, in which:-

Figure 1 is a sectional view of a heat source with a sample arranged to be given a thermal shock test;

Figure 2 is a plan view of an end plate used in the Figure 1 source;

Figure 3 is a perspective view of a cylindrical member used in the Figure 1 source; and,

Figures 4 and 5 are a sectional side-view and a sectional elevation respectively of thermal shock testing equipment comprising a modified form of the Figure 1 heat source.

The illustrated heat source comprises a so-called 'integrating reflector', i.e. an enclosure 1 with reflective internal walls, which is made up of a hollow cylindrical member 2 and two end plates 3 and 4 fixed by screws 5 over the ends of the member 2. The internal surface 6 of cylindrical member 2 is

machined to a radius centred on the axis of the cylindrical member midway between its ends, i.e. so that surface 6 is the surface of a centre-symmetrical section of a sphere. The member 2 and the end plates 3 and 4 are made of brass and their internal surfaces 6 and 7 are polished and silver plated to make them highly reflective. A radially extending hole 8 of a diameter just larger than that of the largest sample to be thermally shock tested is provided in the wall of the member 1, the internal surface of this hole also being polished and silver plated.

Each of the end plates 3 and 4 is provided with a chosen number of slotted holes 10, the holes in each plate being aligned with and opposite respective ones of the holes in the other plate. Meanwhile, mounted inside the enclosure 1 are a series of high-intensity quartz halogen tubular electric filament lamps 11 of the kind which can be had from photographic equipment suppliers. As can be seen, each such lamp comprises a tubular member 12 with a filament 13 extending along inside it between two electrodes 14 which emerge from the ends of the tubular member, these ends being somewhat flattened. The lamps 11 are mounted extending between the slotted holes 10 in the end plates 3 and 4, the electrodes and flattened ends of the lamps protruding through the holes so that the electrodes are exposed, outside the enclosure 1, for electrical connections to be made thereto. In the illustrated source, there are three lamps 11 and correspondingly three holes 10 in each plate 3 and 4. There could be only one or two lamps or there could be more than three, say six or nine.

Each of the lamps might have a rating of 1 kilowatt say, and, as mentioned earlier, they are the type of lamps which are supplied for photographic purposes, i.e. they are such as to give out an intense white light. In the present application, the colour of the light is not important per se except insofar as it implies that the filaments are run at a very high temperature, around 3400°K (unlike the infra-red lamps used for the aforementioned electric cooker hobs).

To use the source, it is mounted say with the hole 8 directed downwards and, just beneath the hole, there is provided a support (not shown) for the sample 15 to be tested. This support could take the form of a sliding tray or the like which enables a series of samples to be quickly and safely installed in the test position.

If the sample is transparent, e.g. if it is a lens or other item of optical material, it is first rendered heat absorbent say by blackening it with any suitable heat resistant coating such as lamp black (one reasonably successful idea was simply to hold the lens over a candle flame for a short time).

Once installed, the lamps are switched on, the radiation therefrom bounces around inside the enclosure and eventually emerges from the hole 8 and becomes incident on sample 15.

Somewhat surprisingly, with an example of the apparatus using four lamps, an enclosure of about four inches diameter by about two inches depth, and a hole 8 of about one inch diameter, a blackened window material sample was able to be

heated to a thousand degrees Centigrade within no more than a few seconds. The term surprisingly is used because the apparatus is so simple and yet the heating rate achieved was of the order that might otherwise require a very powerful oxy-acetylene torch to be played onto the sample.

The test equipment of Figures 4 and 5 again comprises a so-called "integrating reflector", i.e. an enclosure 21 with reflective internal walls, being made up of a hollow body 22 and two side plates 23 and 24 attached by screws 25 to body 22. The internal surface 26 of body 22 defines a section of a sphere. Body 22 and side plates 23 and 24 have their internal surfaces 26 and 27 treated to make them highly reflected. A hole 8 is provided in the wall of body 22 to allow radiant energy to fall upon the test specimen 29, which is mounted in a recess in a sliding tray 212. Instead of a sliding tray, there could be provided a rotating turret support (not shown). The hole 28 may be smaller in diameter than specimen 29 if it is desired to apply a temperature gradient across specimen 29 rather than uniformly distributed heating, which is otherwise obtained. A reflective washer for this purpose could be fitted to the tray.

Each of the side plates 23 and 24 is provided with a hole to allow a quartz halogen lamp bulb 211 to be mounted such that the cap and connections of the bulb are outside of the enclosure 1. In the illustrated example, there are two lamp bulbs 11, one in each side plate, but the number of lamps and the type, e.g. the power rating, may be chosen according to the heating power required, suitable types being readily available with a power

ranging from 500W to 2Kw for photographic and projector use. There might be four lamps for example.

As before, if the sample 9 is transparent, e.g. if it is an item of optical material, then before it is tested it is rendered heat absorbent say by blackening it with any suitable heat resisting coating.

Another embodiment of the heat source (not shown) comprises a sealed quartz bulb of which the whole material surface is rendered highly reflective, e.g. by silver plating, except for a small window portion say one centimetre in diameter. Within the bulb one or more, three say, electric resistance filaments are provided to generate heat which, as before, undergoes multiple reflections (this time within the bulb itself) before emerging via the window onto the test sample. Since the bulb is sealed there is less likelihood of the reflective internal coating becoming tarnished.

There are already available lamp bulbs with reflective coatings on part of the internal surface - they are used in spot lamps for example. In the above described embodiment of the invention however, the reflective coating is provided over virtually all the internal surface apart from the aforementioned small window portion so as to really concentrate the heat radiation by the integrating enclosure effect. Also, the bulb is likely to be made of quartz rather than the usual glass and the filaments would be operable at a much higher temperature than the usual spot lamp bulb.

In all the embodiments described, it may be possible to use a source of heat other than an electrical resistance filament.

CLAIMS

1. A heat source comprising a hollow enclosure of which substantially the whole of its internal surface is optically reflective and which contains one or more high-temperature electric filament lamps, an aperture being provided in the enclosure for heat generated by the or each lamp to emerge from the enclosure.

2. A method of testing a component for heat shock in which the item is positioned close to an aperture in a hollow enclosure of which substantially the whole of its inner surface is highly reflective and which contains one or more high temperature electric filament lamps, the method including energising the lamps whereby the heat therefrom emerges through said aperture onto said item.

3. A heat source comprising a hollow enclosure of which the major part of the internal surface is optically reflective but which has a relatively small optically transmissive portion, and which contains a heat source, heat radiation from the source being operable to undergo multiple reflection from the internal surface of the enclosure and eventually to be emitted, much concentrated, through said transmissive portion.

4. A heat source or test method substantially as hereinbefore described with reference to the accompanying drawings.

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